"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

[illegible] A. V., professor,
Sciences, USSR; Pokhvisnev, A. [illegible]
Trubin, K. G., professor, doctor.

PURPOSE: This book is intended for scientists engaged in [illegible] metallurgical research for plant engineers in [illegible] rolling mills, and forge shops. It may be [illegible] read by technical personnel, workers and students [illegible] this branch of industry.

[illegible] Institute carries out numerous experi- [illegible] dealing with the [illegible]

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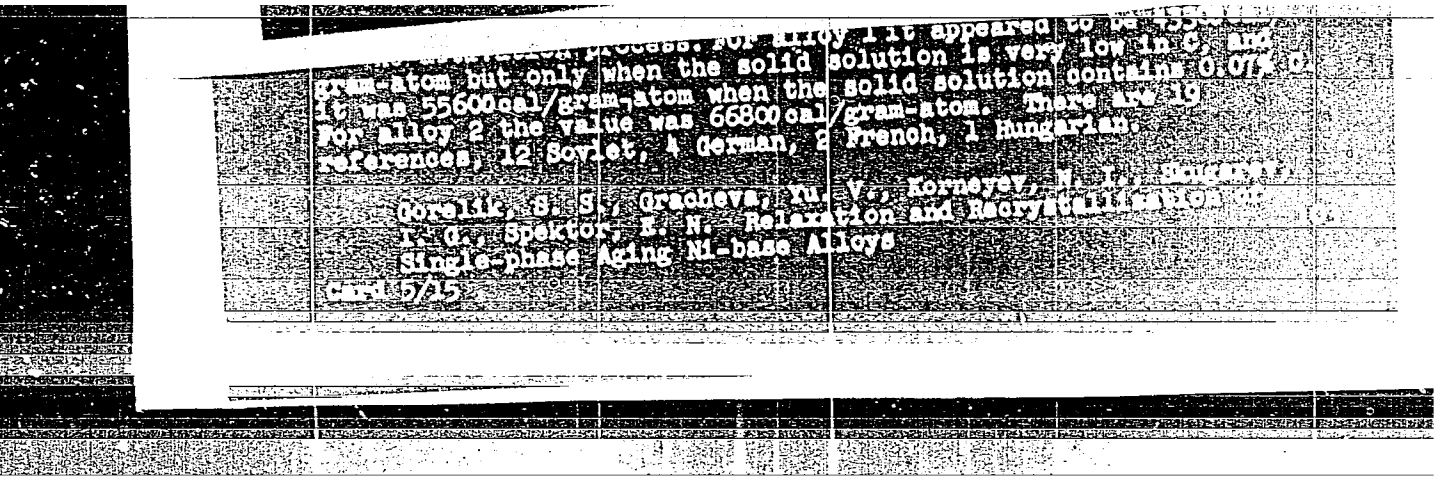

gram-atom but only when the solid solution is very low in C, and
[illegible] was 55600cal/gram-atom when the solid solution contains 0.07% C
for alloy 2 the value was 66800 cal/gram-atom. There are 19
references, 12 Soviet, 4 German, 2 French, 1 Hungarian.

Gorelik, S. S., Gracheva, Yu. V., Korneyev, [illegible]
[illegible], Spektor, E. N. Relaxation and Recrystallization of
Single-phase Aging Ni-base Alloys

Card 15/15

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

GORELIK, S.S.

137-58-4-8182

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 4, p 261 (USSR)

AUTHORS: Gorelik, S.S., Gracheva, Yu.V., Korneyev, N.I., Skugarev, I.G., Spektor, E.N.

TITLE: Relaxation and Recrystallization of Single-phase and Aging Nickel-base Alloys (Otdykh i rekristallizatsiya odnofaznykh i stareyushchikh splavov na nikelevoy osnove)

PERIODICAL: Sb. Mosk. in-t stali, 1957, Vol 36, pp 103-130

ABSTRACT: X-rays were employed to determine the temperature of onset and end of recrystallization due to treatment (t_p^i and t_p^f), and the relaxation processes in hot-worked nichrome base (13% Cr) alloys with added Al, Ti, B, Mo, and W, introduced individually and jointly in various combinations. These factors were studied on the basis of the width and intensity of the (331)α reflexes. The t_p^i and t_p^f curves are presented as functions of the degree of deformation (D), also the relationship of hardness, latiice spacing of the base metal in the alloy, the intensity, and the spread of the (331)α reflex to the temperature of D (which ranged from room temperature to 1200°C). Three-dimensional diagrams of the recrystallization (R) interval were plott[illegible] the following

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Relaxation and Recrystallization (cont.)

coordinates: degree of D, temperature and heating time. It was shown that the individual introduction of B, Mo, and W into nichrome does not result in any significant change in t_p^i, but that an increase in t_p^f occurring in accordance therewith increases the R interval. Separate and joint additions of Al and Ti in various combinations with Mo and W (two-phase alloys) increase t_p^i and t_p^f the more, the higher the temperature boundary of the transition of these alloys to the single-phase state. This is related to the inhibition of R nucleation by aging processes. For single-phase alloys, t_p^i depends upon the degree of D, diminishing with increase in the latter, but in the case of two-phase alloys there is no dependence upon the degree of D. At all temperatures, a greater expansion of the reflexes was observed in the aging alloys. In cases of low D, restoration of the line width and intensity of the alloys studied occurs up to the moment of onset of R. When D is high, this process is only partial and undergoes completion at t_p^i or above. In aging alloys, the processes of removal of lattice distortions are inhibited.

A.B.

1. Nickel alloys--Phase studies

Card 2/2

APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7"

"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

GORELIK, S. S., Cand. Tech. Sci.,

"Effect of certain soluble and insoluble impurities on the recrystallization," with Rozenberg, V. M., Cand. Tech. Sci.; and Rokhlin, L. L., page 522.

In book Problems of Physical Metallurgy, Moscow, Metallurgizdat, 1958, 603p. (Its: Sbornik trudov, v. 5)

The articles in the book present results of investigations conducted by the issuing body, Inst. of Physical Metallurgy, a part of the Cent. Sci. Res. Inst. of Ferrous Metallurgy, located in Dnepropetrovsk. The investigations were concerned with phase transformations in alloys, strengthening and softening processes, diffusion processes (studied with the aid of radioactive isotopes), and certain other questions.

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

SOV/163-58-1-42/53

AUTHOR: Gorelik, S. S.

TITLE: The Temperature Threshold in the Recrystallization of Nickel Alloys (O temperaturnom poroge rekristallizatsii nikelevykh splavov)

PERIODICAL: Nauchnyye doklady vysshey shkoly. Metallurgiya, 1958, Nr 1, pp 226-232 (USSR)

ABSTRACT: By adding a few percent of oxygen and nitrogen to nickel the temperature threshold of recrystallization rises from 300 to 550°, and the ratio T_p/T_{fl} from 0,32 to 0,45.

The temperature threshold of the recrystallization of nickel increases as well when the metals of the fourth, fifth and sixth group are added to the monophases of the solid solutions on nickel basis, viz., in quantities of 5 - 10%. The temperature varies from 675 - 700° and the ratio P_p/T_{fl} up to 0,5.

Especially Mo, V, Cr and Ti of the metals of the fourth, fifth and sixth group are used. The reason for this change in the temperature threshold of recrystallization is disscussed and th author assumes that it is caused by the increase in the interatomic forces in solid solutions.

Card 1/2

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The Temperature Threshold in the Recrystallization of Nickel Alloys

By adding a third component to the alloy Ni-Cr (13%) practically no change in the temperature threshold of recrystallization occurs.
The values T_R/T_P in the aged alloys reach a value of 0,5 to 0,55.
In alloys of complex structure on the basis of Ni-Cr (13%), titanium (2,4%) and Al (2%) the ratio between T_R and T_P changes to 0,25 and the temperature of recrystallization rises from 850 to 950°.
The temperature threshold of recrystallization as well as the ratio T_R/T_P in the aging alloys depend on the position of the boundary between mono- and bi-phase range as well as on the interatomic forces and the dispersion and the distribution character of the components of the alloys.
There are 2 figures, 1 table, and 8 references, 8 of which are Soviet.

Card 2/2

ASSOCIATION: Moskovskiy institut stali (Moscow Steel Institute)

SUBMITTED: October 1, 1957

APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7"

"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

GORELIK, S.S.; MOZZHUKHIN, Ye.I.; MAYYER, Z.

Investigating relaxation and recrystallization in high-melting point titanium and tungsten carbides. Izv. vys. ucheb. zav.; tsvet. met. no.2:153-160 '58. (MIRA 11:8)

1. Moskovskiy institut stali. Kafedra fiziki metallov i rentgenografii.
(Carbides) (Tungsten--Metallography) (Titanium--Metallography)

APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7"

"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

SOV/137-58-7-15690

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 7, p 254 (USSR)

AUTHORS: Gorelik, S.S., Rozenberg, V.M., Rokhlin, L.L.

TITLE: Effect of Some Soluble and Insoluble Additives Upon the Recrystallization of Nickel (Vliyaniye nekotorykh rastvorimykh i nerastvorimykh primesey na rekristallizatsiyu nikelya)

PERIODICAL: Sb. tr. In-t metalloved. i fiz. metallov Tsentr. n.-i. in-ta chernoy metallurgii, 1958, Nr 5, pp 522-527

ABSTRACT: The time of the beginning of recrystallization τ_n was determined by the X-ray method, and the energy of activation of the beginning of recrystallization Q_n was calculated for pure and technical Ni 60% reduced by cold rolling and annealed at 290-600°C and also for its alloys with 2-3.5% Ti and 0.4% C. A very strong effect of the degree of purity of the Ni upon τ_n and Q_n is noted, also a considerable increase of surface energy due to the impurities. It is indicated than an addition of 2-3% Ti to technical Ni produces a certain increase in τ_n. The presence of coagulated carbides in one of the alloys decreased somewhat the effect of Ti on τ_n. The peculiarities of recrystallization of such alloys are explained by an increase

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Effect of Some Soluble and Insoluble Additives (cont.)

within them of the forces of interatomic reaction upon the introduction of Ti and the appearance of deformations in the crystalline lattice upon the coagulation of the carbides.

A. B.

1. Nickel alloys--Crystallization 2. Nickel alloys--X-ray analysis
3. Alloys--Metallurgical effects

Card 2/2

APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7"

"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

GORELIK, S.S., dots., kand. tekhn. nauk; GUTERMAN, M.B., inzh.

Mechanism of recrystallization during the critical stage of deformation. Sbor. Inst. stali no.38:536-547 '58. (MIRA 11:8)

1. Kafedra metallofiziki i rentgenografii Moskovskogo instituta stali im. Stalina.
(Crystallization) (Deformations (Mechanics))

APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7"

"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

SOV/148-59-1-11/19

18(3)

AUTHORS: Gorelik, S.S., Candidate of Technical Sciences, Docent; Bublik, V.T., and Kushnir, I.P., Engineers

TITLE: The Actual Temperature of the Beginning of Recrystallization in Aging Alloys (Ob istinnoy temperature nachala rekristallizatsii stareyushchikh splavov)

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy - Chernaya metallurgiya, 1959, Nr 1, pp 97-104 (USSR)

ABSTRACT: Investigations were carried out for the purpose of determining the cause of high temperature and the actual temperature of beginning recrystallization in aging alloys such as Cu-Be; Cu-Sn; Cu-Ni-Co; Fe-W; Ni-Cr; Ni-Cr-Al-Ti, etc. It was proved by experiments that diffusion processes had only a slight effect on relaxation stresses and on the rise of the t_{rr} temperature (Temperature of the beginning of recrystallization) and could not cause a sharp rise of the temperature of recrystallization as observed in the transition from single-phase to aging alloys. The hypothesis that the actual t_{rr} of aging alloys was lower than the t_{rr} determined by conventional methods, but that its detection was concealed by decomposition,

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The Actual Temperature of the Beginning of Recrystallization in Aging Alloys

was confirmed with the use of direct and indirect radiographic and metallographic methods, the most valuable of which were 1) investigation and correlation of fine structure changes; 2) the microbundle method; 3) analysis of texture dispersion and 4) the method of stepwise heating. It was stated that in aging alloys a difference existed between the actual temperature of recrystallization and the considerably higher temperature of its detection, which corresponded to the beginning of the intensive growth of recrystallization centers. The actual beginning of recrystallization in oversaturated solid solutions occurred simultaneously with the incoherent decomposition of the solid solution. The actual t_{rec} depends on the character of decomposition and can be lower, equal or higher than t_{rec} of the single-phase alloys of limiting concentration.
There are 5 graphs, 3 tables, 2 sets of microphotos and 4 references, 3 of which are Soviet and 1 English.

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SOV/148-59-1-11/19

The Actual Temperature of the Beginning of Recrystallization in Aging Alloys

ASSOCIATION: Moskovskiy institut stali (Moscow Institute of Steel)

SUBMITTED: August 26, 1958

Card 3/3

APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7"

"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

GORELIK, S.S.; SHPICHINETSKIY, Ye.S.; MUKHORTOV, N.F.

Investigating softening and structural changes in deformed "cunico" alloys under the effect of heating. Izv.vys.ucheb.zav.; tsvet. met. 2 no.1:113-120 '59. (MIRA 12:5)

1. Moskovskiy institut stali. Kafedra fiziki metallov i rentgenografii.
(Copper-nickel-cobalt alloys--Testing)

APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7"

"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

18 (7), 18 (6)
AUTHOR: Gorelik, S. S.

SOV/163-59-2-31/48

TITLE: Particularities of the High-temperature Separation of the Solid Solution of the Kuniko Alloy (Osobennosti vysokotemperaturnogo rassloyeniya tverdogo rastvora v splave Kuniko)

PERIODICAL: Nauchnyye doklady vysshey shkoly. Metallurgiya, 1959, Nr 2, pp 176-180 (USSR)

ABSTRACT: Kuniko is a copper-nickel-cobalt alloy with 50% Cu and 20% Ni, which has a high coercive force and is used in the building of apparatus for the manufacture of permanent magnets. The diagram (Fig 1) shows that this alloy remains homogeneous in a limited temperature interval very near the melting point only. Already below 1100°, the alloy becomes two-phase. The homogeneous solid solution is separated into a solid solution rich in copper, and one low in copper, with isomorphic lattices. To investigate the kinetics of this process, the alloy was exposed to temperatures between 1060° and 1000° for various periods of time, and then subjected to an X-ray structure analysis. The hardness was also determined. The results (Figs 2 and 3) show an extraordinary course with

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respect to time. The two-phase state is produced under multiple changes in the concentration of the two simultaneous existing solid solutions. This periodicity has a sinusoidal character with an amplitude fading with time. The maximum hardness corresponds to the minima of the concentration differences. The phenomenon has not yet been fully clarified. The author brings a preliminary explanation. He assumes that the separation into the solid solution rich in copper, and the one low in copper (but rich in cobalt) is caused by diffusion of the two elements Cu and Co. Because of the different diffusion coefficients, the equilibrium is not established at once. The one solution is oversaturated with copper, while the other one shows vacancies. Therefore, the diffusion is reversed until, after some cycles, the equilibrium is established. It is assumed that a similar process occurs in every separation of a solid solution, but in this case appears particularly distinct due to the near melting point and the resulting high mobility of the atoms. There are 3 figures and 3 references, 2 of which are Soviet.

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

Particularities of the High-temperature Separation of the Solid Solution of the Kuniko Alloy SOV/163-59-2-31/48

ASSOCIATION: Moskovskiy institut stali (Moscow Steel Institute)

SUBMITTED: August 5, 1958

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

18(6) SOV/163-59-2-43/43

AUTHORS: Gorelik, S. S., Krimer, B. I.

TITLE: Investigation of the Initial Temperature of the Recrystallization of the Alloys of the Systen Tungsten-Niobium (Issledovaniye temperatur nachala rekristallizatsii splavov sistemy vol'fram-niobiy)

PERIODICAL: Nauchnyye doklady vysshey shkoly. Metallurgiya, 1959, Nr 2, pp 233-237 (USSR)

ABSTRACT: The dependence of the initial temperature of the recrystallization on the concentration of the components in the system tungsten-niobium was investigated. The alloys of this system form a continuous series of solid solutions. Metals of a purity of 99.9 percentages by weight tungsten and 99.4 percentages by weight niobium were used for the production of the alloys. The alloys were melted in a vacuum furnace in an argon protective atmosphere with a tungsten electrode. Several properties of the alloys with purest tungsten and niobium are given in a table. The results concerning the initial temperature of the recrystallization of the solutions investigated are given in the figure. The initial temperature of the recrystallization of niobium and tungsten are 1150, 1000°,

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Investigation of the Initial Temperature of the Recrystallization of the Alloys of the System Tungsten-Niobium

respectively. The results show that the addition of small quantities of the second component (0.5 - 5%) increases the initial temperature of recrystallization by approximately 300°. The maximum initial temperature for the recrystallization of the alloys of the system W - Nb is obtained in tungsten alloys by addition of 5 - 8 gram-atomic percentage niobium. The initial temperature of the recrystallization of alloys of equiatomic composition (50% W and 50% Nb) is only inconsiderably increased. The maximum values for $\frac{T_{solution}}{T_{melt}}$ of the investigated single-phase alloys of these two-substance systems are not higher than 0.50 - 0.55. There are 1 figure, 1 table, and 4 Soviet references.

ASSOCIATION: Moskovskiy institut stali (Moscow Steel Institute)

SUBMITTED: May 8, 1958

APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7"

"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

24 (2) SOV/48-23-5-29/31

AUTHOR: Gorelik, S. S.

TITLE: On the True Temperature of the Beginning of Recrystallization in Oversaturated Solid Solutions (Ob istinnoy temperature nachala rekristallizatsii peresyshchennykh tverdykh rastvorov)

PERIODICAL: Izvestiya Akademii nauk SSSR. Seriya fizicheskaya, 1959, Vol 23, [illegible], Nr 5, pp 657 - 659 (USSR)

ABSTRACT: First, the author reports on results (Refs 1 and 2) obtained from similar investigations concerning the exceedingly high recrystallization temperature of oversaturated solid solutions. The explanation of this high value is important for the theory of alloys, and two causes are pointed out in this connection: 1) the decomposition of the deformed oversaturated solution on heating, caused by a diffusion relaxation of the deformation tensions, brings about an increase of the recrystallization temperature. 2) When heating deformed oversaturated solutions, two processes occur: a) a weakening of relaxation and of recrystallization; b) an intensification of the aging process. Investigations of the stage of the beginning recrystallization were carried out by the aid of X-rays, by microstructural analyses and by the determination of physico-mechanical properties

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

On the True Temperature of the Beginning of Recrystallization in Oversaturated Solid Solutions

SOV/48-23-5-29/31

Table 1 summarizes the compositions of alloys with the alloy bases iron, copper and nickel as well as their properties. Next, the pre-treatment of the samples and experimental methods are discussed. In this connection, the comparative study of the change of fine structure is dealt with first, followed by the investigation method on recrystallization with an X-ray of a very small diameter, and finally, by the analysis of X-ray dispersion of the structure. The final part of the paper gives some results obtained from investigations and considerations are made concerning the energy relations in the phase transformation and recrystallization, and also concerning the relationship between recrystallization and the beginning of decomposition in oversaturated solutions. The experimental part was worked out by V. M. Bublik and I. P. Kushnir. There are 1 table and 4 Soviet references.

ASSOCIATION: Moskovskiy institut stali (Moscow Steel Institute)

Card 2/2

APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7"

GORELIK, S.S.

PHASE I BOOK EXPLOITATION SOV/4782

Moscow. Institut stali

Proizvodstvo i obrabotka stali i splavov (Production and Treatment of Steel and Alloys) Moscow, Metallurgizdat, 1960. 462 p. (Series: Its: Sbornik, 39) 2,100 copies printed.

Ed.: Ye. A. Borko; Ed. of Publishing House: S. L. Zinger; Tech. Ed.: M. R. Kleyman; Editorial Council of the Institute: M. A. Glinkov, Professor, Doctor of Technical Sciences; R. M. Grigorash, Docent, Candidate of Technical Sciences; V. P. Yelyutin, Professor, Doctor of Technical Sciences; A. A. Zhukhovitskiy, Professor, Doctor of Chemical Sciences; I. N. Kidin, Professor, Doctor of Technical Sciences; B. G. Livshits, Professor, Doctor of Technical Sciences; A. P. Lyubimov, Professor, Doctor of Technical Sciences; I. M. Pavlov, Corresponding Member, Academy of Sciences USSR; and A. N. Pokhvisnev, Professor, Doctor of Technical Sciences.

PURPOSE: This book is intended for technical personnel in industry, scientific institutions and schools of higher education, dealing with open-hearth and electric-furnace steelmaking, metal rolling, physical metallurgy, metallography, and heat-treatment. It may

Card 1/10

also be used by students specializing in these fields.

COVERAGE: The book contains results of theoretical and experimental investigations of metallurgical and heat-engineering processes in open-hearth and electric furnaces. Data are included on the following: desulfurizing of pig iron outside the blast furnace, interaction of oxides of the carbide-forming metals with solid carbon, the change of content of gases in the bath of the open-hearth furnace in various periods of melting, intensification of the electric melting of steel, etc. Other articles deal with the nonuniformity of deformation in rolling, the study of the continuous rolling process, the dependence of the friction—slippage coefficients in rolling on a number of factors, and other problems in the pressworking of metals. Articles on physical metallurgy and the theoretical principles and techniques of the heat treatment of steel are also included. No personalities are mentioned. References accompany most of the articles. There are 207 references, both Soviet and non-Soviet.

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Card 9/10

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77705
SOV/148-60-1-28/34

AUTHORS: Gorelik, S. S., Rosenfel'd, A. M., Skakov, Yu. A., Spiridonov, V. B.

TITLE: Nichrome Recrystallization After Slight Deformations as Studied by Emission Microscope EEM-75

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Chernaya metallurgiya, 1960, Nr 1, pp 159-166 (USSR)

ABSTRACT: Two concepts on the formation of coarse grained structures during recrystallization of slightly deformed Nichrome are cited: (1) due to reduced number of recrystallization centers; (2) due to growth and coalescence of several grains. The difficulties in obtaining experimental data are mentioned. The authors produced a Ni-base alloy containing 12.8% Cr, 0.1% C, 0.65% Mn, 0.45% Si, 0.005% S, 0.01% P, forged it into 16-mm rods, annealed at 1,100° C for 1 hr, cut into 20-mm-long cylinders, upset the latter under drop hammer (v = 265 m/min) or press (v = 0.005 m/min) until the

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

Nichrome Recrystallization After Slight Deformations as Studied by Emission Microscope EEM-75

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SOV/148-60-1-28/34

length reduced by 1 to 5%, cut off 1.2 mm plates from the middle part of each cylinder, reduced the plates to 0.3 mm thickness by etching electrolytically in HNO_3 bath at 60 to 70° C and 7 a/cm^2 applied current, electropolished, cut into 3.5 to 4 mm squares, and studied the latter's structure under emission microscope EEM-75 employing 40 kv voltage, 0.00005 to 0.0001 mm vacuum and 900 to 1,200° C at the cathode after a gradual temperature rise. The recrystallization due to thermoelectronic emission was accelerated by covering the plates with a solution of 75 milliliter formic acid, 25 milliliter isopropyl alcohol, and 11 mg barium formate, in some cases also, 8 mg cobalt formate. The course of recrystallization was observed visually and microphotos taken at 3 tc 5 second intervals. The study proved that some grains of Nichrome, deformed to an extent close to a certain critical point (2 to 3%), grow at the expense of other grains until these

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

disappear. No new recrystallization centers emerge unless the preceding deformation exceeded the critical point. Growth around new centers increases with the excessive deformation and can become predominant. Recrystallization reduces surface energy, eliminates concaved surfaces unless the motion of grain boundaries is stimulated by the difference between the elastic energies of adjacent grains. This was the case at the early stage of recrystallization when grains grew faster outside their concaved parts. The later stage flattened grain boundaries, reduced their surface energy, but only slightly increased their volume. During the first stage, boundaries moved with a speed of 0.1 to 1 mm/min, regardless of the degree of preceding deformation, while during the later stage the speed was only about 0.001 mm/min. Thus, the difference between the elastic energies of grains in deformed Nichrome proved to be the principal factor of recrystallization into a coarse grained state. The rapid recrystallization ends

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

Nichrome Recrystallization After Slight Deformations as Studied by Emission Microscope EEM-75

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SOV/148-60-1-28/34

within 20 to 40 seconds and the recrystallization as a whole within 3 to 5 minutes. Coalescence of adjacent grains occurred rarely when their orientations were nearly identical. Emission microscope EEM-75 proved to furnish good results in this kind of investigation. There are 3 figures; and 11 references, 10 Soviet, 1 U.S. The U.S. reference is: R. D. Heidenreich, Journ. of Appl. Physics, 21, 150, 1950.

ASSOCIATION: Moscow Steel Institute and Scientific Research Institute p/ya 4064 (Moskovskiy institut stali i NII p/ya 4064)

SUBMITTED: January 24, 1959

Card 4/4

APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7"

"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

GORELIK, S.S.; ROZENFEL'D, A.M.; SKAKOV, Yu.A.; SPIRIDONOV, V.B.

Mechanism of the formation and disappearance of twins during the heating of deformed nickel-chromium alloys. Izv. vys. ucheb. zav.; chern. met. no.2:105-111 '60. (MIRA 15:5)

1. Moskovskiy institut stali.
(Nickel-chromium alloys--Metallography)
(Crystal lattices)

APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7"

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85459

S/149/60/000/005/011/015
A006/A001

15.2200 2808, 1142, 1411, 1439

AUTHORS: Gorelik, S.S., Mozzhukhin, Ye.I., Yelyutina, V.I.

TITLE: Radiographic Investigation of Recrystallization Processes and Release of a Carbide Phase of Hard Alloys Containing Tungsten, Titanium and Tantalum Carbides

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Tsvetnaya metallurgiya, 1960, No. 5, pp. 121-125

TEXT: The authors used the X-ray method to investigate recrystallization processes and release of a carbide phase in hard alloys containing tungsten, titanium and tantalum carbides, and in solid solutions on tungsten and tantalum carbide base. The compositions of carbide components of the alloys investigated are plotted on a WC-TiC-TaC diagram (Figure 1). The alloys investigated were obtained from the following initial materials: tungsten carbide obtained by tungsten carburization, reduced with hydrogen at 1,350-1,400°C; titanium carbide obtained from a TiO_2 and carbon black mixture by roasting at 2,200°C in hydrogen atmosphere; tantalum carbide obtained by carburization of tantalum metal at 1,600°C. The alloys were carburized with cobalt powder reduced by hydrogen from Co_2O_3. The

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A006/A001

Radiographic Investigation of Recrystallization Processes and Release of a Carbide Phase of Hard Alloys Containing Tungsten, Titanium and Tantalum Carbides

carbide and cobalt powders were mixed in alcohol, dried and screened. Specimens of 5 x 5 x 40 mm were pressed and sintered in a tubular furnace with a graphite heater in hydrogen atmosphere at 1,600°C. The specimens were then deformed by stripping on an abrasive disk and annealed in argon atmosphere. After annealing the specimens were cooled and radiograms were taken using chrome anode irradiation. Annealing was repeated until the appearance of interference spots indicated the formation of 1-2μ grains of carbides. The temperature of the last annealing stage was considered as recrystallization temperature. Temperatures of initial recrystallization (t^{in}_r) and of intensive recrystallization (t_r) for carbide components of 9 alloys investigated were determined as follows:

Alloy	1	2	3	4	5	6	7	8	9
t^{in}_r	1250	1350	1350	1500	1350	1350	1400	1450	1500
t_r	1300	1400	1400	1550	1400	1400	1450	1500	1550

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85459

S/149/60/000/005/011/015
A006/A001

Radiographic Investigation of Recrystallization Processes and Release of a Carbide Phase of Hard Alloys Containing Tungsten, Titanium and Tantalum Carbides

To check the assumption that a decomposition of oversaturated solid carbide solutions during annealing takes place, lattice parameters were determined for the solid solution of TiC-TaC-WC carbides of alloy No. 8 after one-hour-sintering of the specimens at 1,600°C and one-hour-annealing at 1,100, 1,200, 1,300 and 1,450° C. Radiographs were taken with a Kross camera using chrome anode irradiation. The authors investigated moreover release phenomena occurring when annealing alloys 3, 7 and 8. The changes in the width of lines (222) of the radiograms obtained with chrome anode irradiation, were studied. The experiments yielded the following results: From the three mostly used WC, TiC and TaC carbides, tungsten carbide has the lowest (1,250°C), tantalum carbide the highest (1,500°C) and titanium carbide an intermediate temperature of recrystallization (1,440°C). When dissolving WC in a solid TiC-TaC solution, in TaC and TiC, the temperature of initial recrystallization of the solution decreases until a concentration is attained corresponding to saturation. In the bi-phase range the recrystallization temperature of carbide solid solutions does not change with varying compositions of the carbide component of the alloy and of the quantitative phase ratio. At an equal

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Radiographic Investigation of Recrystallization Processes and Release of a Carbide Phase of Hard Alloys Containing Tungsten, Titanium and Tantalum Carbides

content of WC in the carbide solid solution, oversaturated solid solutions have highest recrystallization temperatures. The decomposition of the carbide solid solutions raises the recrystallization temperature on account of the inhibited growth of recrystallization nuclei by particles of the dispersed phase. The magnitudes of substructure domains in deformed surfaces are very close for various compositions of solid solutions of TiC-TaC-WC and for the solid solution of WC in TiC. The decomposition of the solid solution TiC-TaC-WC exerts an inhibiting effect on the growth of substructural domains during release.

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85457

S/149/60/000/005/009/015
A006/A001

Investigation Into Conditions of Titanium-Niobium Carbide Chlorination

The operating chamber of the furnace represents a vertical graphite cylindrical tube with an expanding top pressed into a metallic housing with external heat insulation. A graphite grid is mounted in the chamber bottom. Carbide feed is performed with the aid of a screw feeder. Chlorination process can be conducted at levels of 280 to 420 mm due to the arrangement of discharge pipes at different heights. The furnace is heated with a digitate quartz heater having two heating zones. Chlorides are collected with the use of a condensation system developed by Giredmet. During the chlorination process the graphite accumulates in the bed, concentrates on its surface and is partially eliminated by the gas flow. To bind the carbon and eliminate it in a gaseous state preliminary tests of carbide chlorination were made with a chlorine-oxygen mixture, to form CO or CO_2. The rate of chlorine feed was 2.8 cm/sec for carbide of -100 μ -89%. After the onset of reaction at 200°C, the temperature in the bed raised spontaneously and the lower heater was automatically switched off. The top heater was switched-off at 450°C. When operating with a chlorine-oxygen mixture, the latter was supplied to the furnace at 600°C. At the beginning of the experimental investigation carbide was supplied to the furnace periodically through a funnel and later-on continuously by the screw feeder. Preheated carbide of the following composition was used:

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85457
S/149/60/000/005/009/015
A006/A001

Investigation Into Conditions of Titanium-Niobium Carbide Chlorination

52.40% Ti; 8.85% Nb; 4.67% Si; 0.24% Fe; 0.07% Ca; 12.17% C_{bound}; 11.10% C_{free}; 2.90% N; 7.60% O; etc. The experiments proved the possibility of continuous powder carbide chlorination in a fluidized bed with chlorine or a chlorine-oxygen mixture. The main advantage of the latter method is the elimination of C in the form of CO or CO_2. The process can be conducted in a fluidized bed on account of the reaction heat without an external heat supply even in a small-scale furnace (0.0177 m^2 floor surface). Fluidized-bed chlorination is characterized by a high output (300 kg/hr per m^2 of furnace floor), a high degree of utilization of raw materials (98-99%), and a fairly high purity of the products obtained. These values exceed considerably the efficiency of direct chlorination of ore concentrates in the form of briquets mixed with coal. There are 2 tables, 7 figures and 5 references: 4 Soviet and 1 English.

ASSOCIATION: Krasnoyarskiy institut tsvetnykh metallov (Krasnoyarsk Institute of Non-Ferrous Metals) Kafedra metallurgii redkikh metallov (Department of Metallurgy of Rare Metals)

SUBMITTED: December 10, 1959

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83290

S/148/60/000/007/011/015
A161/A029

2308 only 2208 18.7500

AUTHORS: Gorelik, S.S.; Myuller, N.N.

TITLE: Dependence of Binary Chromium Alloys Recrystallization Temperature on Alloying Components

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Chernaya metallurgiya, 1960, Nr 7, pp 146-155

TEXT: The temperature of beginning recrystallization shows approximately the heat resistance of metal, and the effect of different additives is of practical interest. The effect of B, Be, Al, Ti, Fe, Zr, Nb, Mo, W, and Sb on the temperature of recrystallization beginning was studied here, as well as of chromium smelted by different methods. The composition of the studied alloys and Cr are given (Tables 1 and 2). The alloys were smelted in alundum crucibles in an induction furnace in an argon atmosphere and poured into a copper ingot mold; an unalloyed Cr ingot was prepared in the same way. The distribution of alloy elements was determined by spectrum analysis, the microstructure by electrolytic pickling in 10%-HCl, the beginning recrystallization temperature by the X-ray method which is

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A161/A029

Dependence of Binary Chromium Alloys Recrystallization Temperature on Alloying Components

usually employed for investigating the recrystallization of high-melting and brittle materials /Ref 1/. The article includes details of experimental techniques. The data obtained led to the following conclusions. 1) Addition of small quantities of Mo, W, Fe, Al, Be, B, Ti, Nb, Ta, Zr and Sb [0.03-5% (atomic)] raises the beginning recrystallization temperature, or "t_p^H" (t_r^b), of Cr. 2) For binary alloys that have one phase in this concentration range, the increase of t_r^b was 20-100°C. It is proportional to the effective atomic diameter difference of Cr and the alloying element. In aging binary alloys t_r^b raises by 200-250°C. Aging Cr-Ti, Cr-Ta, Cr-Nb and Cr-Sb have the highest t_r^b (1,000-1,060°) and a recrystallization temperature/fusion temperature ratio above 0.60. The abrupt increase of t_r^b in these alloys is due to the inhibiting effect of the second phase on the growth of forming crystals. 3) In single-phase binary Cr alloys containing several atomic per cent of the alloying element, t_r^b depends on the way this element affects the strength of the interatomic bond. If the bond strength drops, t_r^b decreases and may be

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A161/A029

Dependence of Binary Chromium Alloys Recrystallization Temperature on Alloying Components

below that of Cr, as for example in alloying with iron. If the additive raises the interatomic bond, the recrystallization temperature rises, e.g. in alloying Cr with tungsten and molybdenum. Repeated remelting of Cr in a neutral atmosphere without crucible, and reduced saturation of Cr by gas and products of the reaction with the crucible material, lowers the recrystallization temperature from about 800 to 750°C. There are 3 figures, 4 tables, and 6 references: 4 are Soviet, 1 English and 1 German.

ASSOCIATION: Moskovskiy institut stali (Moscow Steel Institute)

SUBMITTED: November 5, 1959

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

S/129/60/000/009/004/009
E193/E483

AUTHORS: Gorelik, S.S., Candidate of Technical Sciences, Faynbron, S.M., Katkova, A.M. and Shelgayeva, L.V., Engineers

TITLE: Causes of the Formation of Cracks During the Forging of Bars

PERIODICAL: Metallovedeniye i termicheskaya obrabotka metallov, 1960, No.9, pp.17-19

TEXT: The object of the investigation, described in the present paper, was to study the effect of the cast structure of the alloy EI437B on its hot workability. To this end, cylindrical specimens, 10 mm in diameter and 20 mm high, were cut from both the outer columnar crystals and the inner equiaxial grains' zones of the ingot, the axes of the specimens being parallel to the ingot axis and normal to the axes of the columnar grains. The specimens were then subjected to various degrees of plastic deformation at room and elevated (950 to 1050°C) temperatures, an Amsler drop-hammer having been used for this purpose. In contrast to specimens consisting of equiaxial grains, those cut from the columnar crystals' zone did not deform uniformly, as

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Causes of the Formation of Cracks During the Forging of Bars

indicated by the change of the shape of their cross-section from circular to elliptical. This effect was found to be due to the columnar crystals being more ductile in the direction of their longer axes, the degree of anisotropy of plastic deformation increasing with rising temperature and increasing degree of deformation. The anisotropy of plastic deformation, attributed to the difference in ductility of the interior of the columnar crystals and grain-boundary layers, caused the formation of cracks during hot rolling of material with traces of columnar structure. Although the harmful effects of the presence of columnar grains in alloy EI437B can be minimized by strict control of the forging temperature and degree of deformation, it was concluded that even a small proportion of columnar grains in this alloy renders it unsuitable for critical applications or for manufacture of forged articles of complex shape. There are 2 figures and 2 Soviet references.

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S/148/60/000/009/017/025
A161/A030

18.1000 1496 1454, 1416

AUTHORS: Gorelik, S.S., and Spektor, E.N.

TITLE: The dependence of the recrystallization temperature level in single-phase nickel alloys from alloying

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Chernaya metallurgiya, no. 9, 1960, 120-131

TEXT: The problem had been studied in only few systematical works (Ref.1-6) and the explanations of dependence are complex, not sufficiently grounded and need verification. In the subject work the regularity of the effect of soluble additives was studied in a wide content range (from 0.1 to 10%) in binary single-phase nickel and iron base alloys (Tables 1 and 2). The base of nickel alloys was electrolytic nickel of 99.98% purity melted in vacuum and cast into 200-300 g ingots that were forged, annealed, rolled to 3 mm thickness and annealed again for cold rolling; the iron base alloys were melted in an open induction furnace under slag; ingots were forged, annealed and drawn to 1.5 mm and annealed again; the final deformation was by drawing. The temperature at the first recrystallization (t_p^H) was deter-

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The dependence of the recrystallization...

mined by the appearance of first interference spots on the background of blurred X-ray interference lines; X-ray pictures were taken in cylindrical chambers in Fe-K_α radiation; the period of solid solution grid in nickel alloys was determined in a ionization unit УРС-50II (URS-50I) in Cu-K_α radiation, and in iron alloys in a cylindrical chamber. The characteristical temperatures Θ and values $m\Theta^2$ (m - reduced mass of alloy atoms) were determined; Θ was determined roentgenographically using the method described in (Ref.7), and the characteristical temperature by variations of the frequency of resilient oscillations (Ref.8) with an accuracy of about $\pm$ 1° K. It was stated that small additions always raised t^H_p, but the recrystallization temperature effect of different elements was different: 0.1% (at.) Ti raised t^H_p in nickel nearly 200°C, 0.1 W only 150°, same quantity of Mo only 50-75°, and of iron and vanadium only insignificantly. The t^H_p rise sometimes stopped and even dropped with increasing content of the second component, and a new rise of t^H_p started mostly with still higher concentration. But a drop instead of a rise of t^H_p was observed in separate systems (Fig.1b) to temperature below the t^H_p of iron (the base). A similar effect had been revealed in alloying chrome with iron (Ref.9). The degree of deformation boosted the

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The dependence of the recrystallization...

effect of low content of the second component (Fig.2). The total maximum t^{H}_{p} variation range in nickel base alloys was 200-250°C, and iron-base alloys 150-200°. The mechanism of the effect of alloying additions is discussed. Conclusions: 1) The regularity of the additives effect on the temperature level and kinetics of recrystallization in binary single-phase nickel and iron base alloys has been studied. 2) It is proven that the effect of low and high contents of soluble additive is caused by various factors. 3) Low additions always raise the recrystallization temperature, and this the more the greater is the difference between the atomic radius of the additive from the atomic radius of the matrix. The additive atoms tend to stay in the boundary and defective spots in the grid, and this not on account of the relation of surface tension, but mainly on account of the difference between the atomic radii of the base and the additive. The result is a drop of the surface energy and total free energy in the system, the heterogeneity of the grid distortions reduces, and this makes the formation and growth of recrystallization centers more difficult. The assumption has been made that the growth of recrystallization centers is inhibited additionally by the necessity of diffusion - "chasing" of the additive atoms in front of the moving boundary. 4) The effect of high contents of soluble additive is due to the

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nature of the variation of interatomic bond in solution. The beginning recrystallization temperature raises with increasing bond forces, and drops when the bond forces weaken, and may drop below the recrystallization temperature of the base. 5) In the range of high concentrations the recrystallization temperature of solid solutions varies in a function of content of the additive, and more smoothly than in the low concentration range, and depends less on the degree of deformation. 6) The effect of soluble additive in the range of medium concentrations (0.5 - 1.5% at.) depends on the relation between the weakening of the surface effect and the intensity of growing bond forces. There are 8 figures and 14 references: 11 Soviet-bloc and 3 non-Soviet-bloc.

ASSOCIATION: Moskovskiy institut stali (Moscow Steel Institute)

SUBMITTED: 14 December 1959

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GORELIK, S.S.

82641
S/126/60/010/02/011/020
E021/E335

18.7500

AUTHORS: Gorelik, S.S., Kal'yanova, S.M. and Rozenberg, V.M.

TITLE: Structural Changes in Aluminium With Slight Deformation and a Subsequent Annealing

PERIODICAL: Fizika metallov i metallovedeniye, 1960, Vol. 10, No. 2, pp. 251 - 261

TEXT: AV-000 aluminium containing traces of magnesium, silicon and copper was used in the investigation. Deformation was produced on a 5-ton press at 21 mm/min. The number of slip marks, the vertical component of displacement in the slip marks and the vertical component of displacement of grains relative to one another were measured on an interference microscope by the method described in earlier work (Ref. 3). The mean grain size was also found. Migration of the grain boundaries during recrystallisation was found by a method using polarised light (Ref. 5). The critical degree of deformation using an annealing temperature of 400 °C was found by constructing a graph of grain size after annealing against degree of deformation. It was found to be approximately 6.5%. Fig. 2 shows the influence of small degrees of deformation on the number of slip marks, the mean dis-

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E021/E335

Structural Changes in Aluminium With Slight Deformation and a Subsequent Annealing

placement in the slip marks, the mean displacement between the grains and the ratio of the last two, in descending order. This shows that the basic mechanism of plastic flow, with or without the critical degree of deformation, is the same - slip in the grains accompanied by displacement of the grains relative to one another. After deformation less than the critical value, structural changes during annealing occur, in the main, by polygonisation, with a small degree of migration of boundaries of individual grains, stimulated by the tendency to decrease the surface energy of a system (Figs. 3, 4). Very occasionally, migration of the boundary occurs because of differences in volume energy of adjacent grains (Fig. 5). After deformation greater than the critical amount, annealing at 400 °C is accompanied by intensive growth of individual crystallites and frontal migration of boundaries which is stimulated by differences in volume elastic energy of adjacent grains. The rate and distance of migration of boundaries is many times greater than that stimulated by surface energy differences. Intensive growth occurs after an

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E021/E335

Structural Changes in Aluminium With Slight Deformation and a Subsequent Annealing

incubation period during which redistribution of the energy inside the grains occurs (Figs. 6-8). After deformation many times greater than the critical amount, new grains arise between the original grains at places of maximum distortion. The orientation of the new grains differs sharply from those surrounding it. This occurs after an incubation period of 6 to 30 minutes. There are 8 figures, 1 table and 7 references: 6 Soviet and 1 English.

ASSOCIATION: TsNIIChM

SUBMITTED: March 19, 1960

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

S/126/60/010/006/008/022
E193/E483

AUTHORS: Vishnyakov, Ya.D. and Gorelik, S.S.

TITLE: Stacking Faults in Cold-Worked Nickel and Nichrome

PERIODICAL: Fizika metallov i metallovedeniye, 1960, Vol.10, No.6, pp.841-852

TEXT: The experimental specimens used in the course of the present investigation consisted of nichrome (13.3% Cr) filings either untreated (i.e. in the cold-worked condition) or vacuum-annealed (30 min at 1000°C, followed by water-quenching), and nickel powder (obtained by hydrogen reduction of nickel oxides at 400°C) either untreated (i.e. in the annealed condition) or cold-worked by ball-mill grinding for 48 h. Analysis of the results of X-ray diffraction measurements led the present authors to the following conclusions. (1) The presence of deformation-induced stacking faults in metals with face centred cubic lattice brings about displacement of the X-ray diffraction lines which, at the same time, become weaker and more diffuse. The magnitude and sign of the displacement depends on (hkℓ), where h, k and ℓ are the indices of the cubic lattice, and the decrease in the intensity of X-ray diffraction is most pronounced in the case of

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Stacking Faults in Cold-Worked Nickel and Nichrome

the lines (200) and (400). The magnitude of all three effects increases with increasing concentration of the stacking faults. (2) The concentration of stacking faults in heavily deformed nickel and nichrome is approximately 1 and 2% respectively. The relatively higher concentration of stacking faults in nickel (most likely attributable to the presence of chromium in the alloy) is reflected in the magnitude of their effect on the X-ray diffraction pattern. (3) If the effects of stacking faults are taken into account, the average size of the coherently reflecting regions in heavily deformed specimens is 470 Å in the case of nickel and 390 Å in the case of nichrome; if the effect of stacking faults is disregarded, these figures become 300 and 170 Å respectively. (4) The decrease in the lattice parameter of nickel powder brought about by heavy deformation, caused by ball-mill grinding, is most likely due to (a) the formation of vacancies during deformation and (b) migration of impurity atoms to the grain-boundary regions. (5) The decrease in the lattice parameter of nickel filings brought about by vacuum-annealing at

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E193/E483

Stacking Faults in Cold-Worked Nickel and Nichrome

approximately 1000°C, can be attributed to volatilization of chromium which takes place during this treatment and which is accompanied by the formation of vacancies. There are 6 figures, 4 tables and 14 references: 4 Soviet and 10 non-Soviet.

ASSOCIATION: Moskovskiy institut stali im. I.V.Stalina
(Moscow Steel Institute imeni I.V.Stalin)

SUBMITTED: April 25, 1960

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APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7"

"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

GORELIK, S.S., dotsent, kand.tekhn.nauk; ROMASHOV, V.M., inzh.; SHCHEDRIN, Ye.I., inzh.

Effect of dedormation distortions and aging on the rate of diffusion in nickel-base alloys. Sbor. Inst.stali no.39: 381-399 '60. (MIRA 13:7)

1. Kafedra fiziki metallov i rentgenografii Moskovskogo ordena Trudovogo Krasnogo Znameni instituta stali im. I.V.Stalina.
(Nickel-chromium alloys—Cold working)
(Diffusion)

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GORELIK, S. S.

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PHASE I BOOK EXPLOITATION SOV/5685

Fridlyander, I. N., Doctor of Technical Sciences, and B. I. Matveyev, Candidate of Technical Sciences, eds.

Teploprochnyy material iz spechennoy alyuminiyevoy pudry [SAP]; sbornik statey (Heat-Resistant Material From Baked Aluminum Powder [SAP]; Collection of Articles) Moscow, Oborongiz, 1961. 122 p. Errata slip inserted. 3,550 copies printed.

Reviewers: M. F. Bazhenov, Engineer, and M. Yu. Bal'shin, Candidate of Technical Sciences; Ed.: M. A. Bochvar, Engineer; Ed. of Publishing House: S. I. Vinogradskaya; Tech. Ed.: V. I. Oreshkina; Managing Ed.: A. S. Zaymovskaya, Engineer.

PURPOSE : This collection of articles is intended for scientific workers and engineers in the institute and plant laboratories of the metallurgical and machine-building industry; it may also be useful to instructors and advanced students.

COVERAGE: The 12 articles contain the results of research on the structure, properties, and manufacture of semifinished products

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

from sintered aluminum powder. The technology for the manufacture of aluminum powder and briquets is described as are sintering processes, and pressing, rolling, drawing, and sheet-stamping methods. The dependence of the properties of semifinished products on the aluminum-oxide content of the powder, on the degree of hot and cold deformation, and on the stresses of pressing is investigated. Also investigated are the mechanical and corrosive properties of semifinished products, the mechanism of hardening of sintered aluminum powder, the reasons for blister formation, and the possibility of recrystallization. Data on sintered aluminum alloys are included. No personalities are mentioned. References in the form of footnotes accompany the articles.

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S/129/61/000/003/003/011
E073/E335

18.1500 1145, 1413

AUTHOR: Gorelik, S.S., Candidate of Technical Sciences,

TITLE: Mechanism of Recrystallisation After Small Rates of Deformation

PERIODICAL: Metallovedeniye i termicheskaya obrabotka metallov, 1961, No.3, pp. 12 - 17 + 1 plate

TEXT: Two basic points of view exist on the mechanism of formation of a structure during recrystallisation after small deformations. S.S. Shteynberg, E. Houdremont, D.M. Nakhimov, R. Meyl and others consider that the mechanism of recrystallisation is the same after critical and after larger deformations and takes place as a result of formation of nuclei of new undistorted grains. A coarse grain cracking after critical deformation is caused by a small number of these nuclei. Ye.M. Savitskiy, A.P. Gulyayev, Ya.R. Rauzin and the author of this paper consider that large grains form during the growth of some of the original grains at the expense of others. In this paper, experimental data are presented on the mechanism of structural changes during heating

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E073/E335

Mechanism of ....

after slight deformations. Focused X-ray exposures and metallographic methods of analysis were used in the experiments. The X-ray diffraction patterns obtained for an alloy of Fe + 3% Si deformed by upsetting indicated that the basic process of structural changes during heating is polygonisation. During heating, the distorted crystallite sub-divided, owing to redistribtuion of the dislocations, into fragments which were not greatly distorted and which were slightly disorientated relative to each other. During heating after critical and hypercritical deformation a small number of large point reflexes appeared instead of the blurred reflexes. Polygonisation reduces the magnitude and the gradient of the microstresses. It is obvious that the conditions for subsequent recrystallisation will deteriorate if polygonisation is completed before the beginning of recrystallisation. Polygonisation can be avoided by rapid heating and this should facilitate the progress of critical recrystallisation. According to X-ray analysis, polygonisation occurred after heating at 400 °C for 30 min. but was not observed after

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E073/E335

Mechanism of Recrystallisation ....

heating at 300 °C. Preliminary relaxation has a differing influence on the grain size after recrystallisation and depends on the degree of deformation. At small degrees of deformation relaxation reduces the dimensions of the grains which form during subsequent recrystallisation. If the relaxation conditions are correctly chosen, this decrease may be so great that the pronounced coarsening of the grains will cease. Obviously, if coarse grains are undesirable and low degrees of deformation are unavoidable, preliminary heating is advisable. Relaxation after high degrees of deformation will bring about an increase in the final grain size. The main mobile force of the critical recrystallisation are the elastic body stresses in the individual crystallites. According to X-ray analysis, the nonuniformity of the deformation of the individual grains is greater at higher deformation speeds. On increasing the degree of deformation above the critical range, the nonuniform deformation will be more localised. The following conclusions are arrived at:
1) the mechanism of formation of the structure during heating deformed metals depends on the degree of deformation.

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E073/E335

Mechanism of Recrystallisation ....

The heating of specimens deformed below the critical value is accompanied by polygonisation; heating to the critical deformation will lead to growth of some of the initial grains at the expense of others; heating above the critical value will lead to the formation and growth of new grains. The curve of the dependence of the grain after recrystallisation on the degree of deformation is the resultant curve totalling the influence of the two described processes, each of which is characterised by its dependence of the grain size on the deformation and heating conditions.

2) Coarsening of the grains during recrystallisation after critical deformation must be considered as a particular case of secondary recrystallisation. The basic course of a critical recrystallisation is the nonuniformity of the deformation and the presence of a gradient of body stresses in adjacent grains. Contacts between the grains are a necessary but not a determining condition of critical grain growth.

3) The magnitude of critical deformation depends on the

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Mechanism of Recrystallisation ....

temperature and speed of heating and on the nature of the deformation. Factors which bring about an increase in the deformation nonuniformity (high speed of deformation, large initial grain) lead to a reduction in the magnitude of the critical deformation. Factors which prevent polygonisation, raise the annealing temperature and increase the heating speed will have a similar influence. With changing deformation speed, the local nature of stress distribution of the micro-volumes will change and this influences the nature of changes in the microstructure during heating.

4) Preliminary relaxation of the deformed metal will affect unequally the final dimensions of the grain after recrystallisation annealing. In a metal subjected to a small degree of deformation, the dimensions of the grain will decrease after reversal. However, at larger degrees of deformation the grain dimensions will increase. A decrease in the grain dimensions by preliminary relaxation after critical deformation will be achieved only if polygonisation occurs in the metal during relaxation. This phenomenon can be utilised for reducing the grain size during heating of a metal that has

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Mechanism of Recrystallisation ... E073/E335

deformed to a critical degree. There are 8 figures and 6 Soviet references.

ASSOCIATION: Moskovskiy institut stali (Moscow Steel Institute)

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

S/148/61/000/003/011/015
A161/A133

18.7500 1416

AUTHORS: Gorelik, S. S., Spektor, E. N., Minkina, S. N.

TITLE: Investigating the concentration dependence of the recrystallization temperature level in two-component nickel alloys

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Chernaya metallurgiya, no. 3, 1961, 138 - 147

TEXT: It had been revealed in two previous works that the dependence of the temperature of the beginning of recrystallization (t_r^b) on the concentration of elements in two-component single-phase alloys is of a rather complex nature (Ref. 1 and 2: S. S. Gorelik and E. N. Spektor, Izv. vyssh. uch. zav. Chernaya metallurgiya, 1960, no. 9, and no. 7). The present article presents the results of an investigation of three alloy systems: Ni-Be, Ni-Co, and Ni-Al, in which the second component has either a considerably smaller, or an almost equal, or a considerably larger atomic radius than nickel. The previous data (Ref. 1) led to a new explanation of the causes of the drop of t_r^b after the first maximum in the low-concentration range - that the increasing content of the second element results in a saturation of the lattice boundaries and dislocation spots with the

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Investigating the concentration dependence of the...

second element atoms, the surplus of these atoms dissolves in the grain volumes, and this results in a weakening of the effect at dislocations at the time when the bond forces are not yet sufficiently developed. This theory needed an experimental verification. The described work included a comparative study of the effect of Cr in nichrome alloys. The t_r^b point in all alloys was determined by the conventional X-ray method according to the appearance of the first interference spots on the background of the blurred lines. The metal specimens were prepared from metals smelted in vacuum and without vacuum, forged, annealed for homogenation and rolled with 20 and 70% reduction at room temperature. The lattice periods were determined with the aid of a УРС-50И (URS-50I) ionization unit, with $\pm$ 0.0003 kX accuracy. The data obtained proved that low additions always raised the t_r^b of the solvent, also in the case of the atomic radius of the additive being shorter than that of the solvent; e.g. Be raised the t_r^b of Ni abruptly by 200°C. It is difficult to explain but deserves attention that the t_r^b -raising effect of Be ends at 1.8% Be, i.e., at higher concentration than in the case of other additives. The decrease of t_r^b starts only when the Be-content begins to exceed 1.8%. The small size of the Be atom may be the cause of this. Besides, nickel added to copper in a quantity of 0.1% also raised the t_r^b of copper, whose atomic radius is larger than that of Ni. This observation confirms the conclusions made in (Ref. 1) but contradicts the data of two other works (Ref. 3: L. P. Kurilekh, Metallovedeniye

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Investigating the concentration dependence of the ...

i obrabotka metallov, no. 9, 1959; Ref. 4: E. Pipitz, R. Kieffer, Zeitschrift Metallkunde, 1955, no. 3, 5, 187). Obviously, the effect of a higher degree of deformation raised the effect of low additions on the t_r^b due to a greater number of dislocations and higher elastic stresses. The clearly expressed maximum of t_r^b that was stated in alloys melted without vacuum is explained by the effect of gas atoms (nitrogen in the first place). Conclusions: 1) It has been confirmed that the t_r^b -raising effect of low soluble additions is determined mainly by the absolute difference of the atomic radii, and that this effect is the higher the higher the difference of the atomic radii. The solubility of the additive, its effect on the bond etc. also has an additional effect; 2) It has been confirmed that the decrease of t_r^b observed in many systems after the first maximum in the low-concentration range is connected with the begin of dissolving of the additive's atoms in the grain after saturation of defective spots in the lattice; 3) It has been proven that the abrupt raise of t_r^b in nickel from low Cr additions in the case of melting without vacuum is the result of the combined effect of Cr and gases dissolved in Ni. In vacuum-melted alloys, low Cr additions raise t_r^b of Ni considerably, but not so high as in alloys melted without vacuum, and less than high Cr concentrations. There are 6 figures, 2 tables and 8 references: 7 Soviet-bloc and 1 non-Soviet-bloc.

ASSOCIATION: Moskovskiy institut stali (Moscow Steel Institute)

Card 3/3 SUBMITTED: November 24, 1960

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S/148/61/000/005/007/015
E073/E435

AUTHORS: Gorelik, S.S. and Myuller, N. M.

TITLE: Features of the change in the fine structure of chromium and its alloys during deformation

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Chernaya metallurgiya, 1961, No.5, pp.129-131

TEXT: The authors established in earlier work (Ref.1: Izv. vysshikh uchebnykh zavedeniy, Chernaya metallurgiya, 1960, No.7) that chromium of 99.98% purity melted without a crucible possesses a relatively high recrystallization temperature, $T_r/T_{fus.} = 0.48$. This is considerably higher than the corresponding ratio for other metals of the same degree of purity. There was a possibility that these features of recrystallization of chromium and of its alloys were due to the features of its fine structure in the deformed state. Therefore, the authors carried out parallel investigations on the changes in the fine structure during deformation of chromium and of some of its alloys and also of iron. They analysed the widening of the X-ray lines in the deformed state so as to determine the role of the dispersion of the structure and

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the microstresses on this widening. Analysis of the widening of the lines of chromium and its alloys was on specimens work hardened by deformation in a mortar and also on specimens work hardened by surface scratching by means of an abrasive wheel. The powder deformed in a mortar was used for producing specimens in the form of a layer on a glass fibre. The X-ray patterns were made in a cylindrical chamber D = 57.3 mm and as a reference standard powder of the alloy in the annealed state was used, Cr-Fe (22%). In addition to pure chromium specimens, Cr-Fe (22% Fe) and Cr-Ta (0.81% Ta) alloys were investigated. Under the same conditions of exposure, the widening of the lines of work hardened iron was determined; the iron powder was produced by filing. The widening was analysed by the approximation method using as an approximate function $1/1 + \alpha x^2$. The calculation was carried out by comparing the widening of the lines $(110)\alpha$ and $(211)\alpha$, using the radiation from a chromium alloy. The obtained results indicate that deformation of chromium is accompanied basically by dispersion of the structure and it leads to the creation of slight elastic stresses which are such that they do not have an influence on the widening of the X-ray diffraction lines. This conclusion is

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correct also for the investigated Cr-Ta and Cr-Fe alloys and conclusive evidence of the correctness of this conclusion is the fact that analysis of deformed iron gave an opposite result, namely all the widenings proved to be due to microstresses. The following conclusions are arrived at: 1. The Structural changes during deformation of chromium and its alloys mainly consist in refining of the structure. The microstresses are relatively low and do not have any influence on the widening of the X-ray diffraction patterns. 2. The assumption is expressed that the high relative recrystallization temperature ($T_r/T_{1us.} = 0.48$) is associated with the low value of the microstresses and the weakened role of elastic distortions in accelerating recrystallization. The latter proceeds basically as selective recrystallization which is stimulated primarily by the tendency of the system to be in a state for which the surface energy of the system is at a minimum. There are 1 table and 3 references: 2 Soviet-bloc and 1 non-Soviet-bloc.

ASSOCIATION: Moskovskiy institut stali (Moscow Steel Institute)
SUBMITTED: January 20, 1961
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S/129/61/000/007/010/016
E021/E135

AUTHORS: Gorelik, S.S., Candidate of Technical Sciences, and Vaynblat, Yu.M., Engineer

TITLE: Coarse-grained rim in extruded components of aluminium alloys

PERIODICAL: Metallovedeniye i termicheskaya obrabotka metallov, 1961 No.7, pp. 38-43

TEXT: The method of hot extrusion of aluminium alloys, which is widely used, often gives rise to a coarse grained recrystallised rim on heating and quenching the extruded component. In this zone the strength of the material is considerably lowered and cracks can form more easily. A study was therefore made of the formation of the coarse grained rim on AV1al type alloys. The chemical compositions (%) of the aluminium base alloys used in the investigation are given in the table (1 - AV1al, 5 - Aluminium). Rods 100 mm in diameter were extruded from continuously cast billets 320 mm in diameter, the billet temperature being 470 °C and the chamber temperature 400 °C. Specimens were cut from the rod and some of them were subjected to quenching from 500 - 590°C.

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Coarse-grained rim in extruded S/129/61/000/007/010/016
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The hardness, electrical resistance, solid solution lattice parameter, texture and microstructure of samples after extrusion and samples after heat treatment were determined. The obtained microphotos show that the secondary phase in the periphery was less dispersed after extrusion than in the centre. The lattice parameter of the solid solution in the peripheral zone was 0.0012 kX greater than in the centre, the electrical resistance was 2 - 3% lower, and the hardness lower by nine H_B units. The texture in the centre was <111> and <100>, and in the peripheral zone <211> with weaker <111> and <100>. After quenching from 518 °C there was no substantial difference in physical properties or lattice parameter. The main difference was in the structure. At the back end of the rod there was a coarse grained peripheral zone 20 mm wide gradually narrowing to 1 mm at the front. The width of the zone increased with increase in annealing time (Fig.2a; rim width mm vs. time, mins, annealing at 518 °C) and with increase in annealing temperature (Fig.2b). The coarse grained rim is formed because of non-uniform conditions of growth of the nuclei of recrystallisation arising in the process of extrusion. This is connected with non-uniform

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Coarse-grained rim in extruded S/129/61/000/007/010/016
E021/E135

decomposition of solid solution and non-uniform distribution of dispersed phases. Ye.M. Miklashevich participated in the experimental work. There are 4 figures, 1 table and 5 Soviet references.
ASSOCIATION: Moskovskiy institut stali (Moscow Steel Institute)

Table

Alloy No.	Material	Chemical composition, %			
		Cu	Mg	Mn	Si
1	Avial	0.49	0.76	0.39	0.96
2		0.50	0.77	0.10	0.97
3		0.33	1.24	0.01	1.02
4		0.59	1.25	0.35	1.07
5	Aluminium	0.01	0.01	0.01	0.05

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187500 85916 S/126/61/012/001/008/020
E111/E435

AUTHOR: Gorelik, S.S.

TITLE: Activation energy of recrystallization and evaluation of the recrystallization capability of metals and alloys

PERIODICAL: Fizika metallov i metallovedeniye, 1961, Vol.12, No.1, pp.55-63

TEXT: To keep pace with technical requirements more work has recently been devoted to the influence of alloying on metal and alloy recrystallization. The question of evaluating the recrystallization capability is therefore important. The author and others (Ref.2: Sb. trudov In-ta stali, No.36, 1957) have proposed that it should be evaluated from the temperature thresholds of its start and finish. The thresholds were taken as the annealing temperatures below which, with the holding times used in practice, recrystallization did not start or finish, respectively. In fact, 2 to 3 hours holding time was found to be sufficient. The present work gives some additional experimental results on the activation energy Q of recrystallization and the threshold for

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the finish of recrystallization t_p^H as functions of alloying-component content in Fe-V, Fe-Mo, Ni-Cr, Ni-Fe and Ni-V (Fig.4, Q in kcal/mol, t_p^H in °C). From his additional work and the literature, the author draws the following conclusions. The activation energy of recrystallization as determined from the time for the start of recrystallization τ at various absolute temperatures T using the relation $\tau = Ae^{Q/RT}$ reflects the effect of temperature on the process rate. It is the effective activation energy of a combination of at least three elementary processes: relaxation, formation of recrystallization nuclei, and growth of nuclei to detectable dimensions. Each has its own activation energy. If there is a sharp change in the rate, and especially the mechanism of even one of these, the temperature dependence (and hence the value of Q) of the whole recrystallization process rises greatly. Q then loses its meaning of activation-energy (even average), retaining only that of temperature dependence of recrystallization and then only for the temperature range in which it was determined. Factors with the greatest effect on the rate of elementary processes include:
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a) In ageing and heterophase alloys, the presence of many disperse-phase particles which prevent growth of recrystallization nuclei over a definite temperature range; if both the number and dispersion of particles alter with temperature, the growth rate of nuclei also changes. b) In single-phase alloys, the occurrence of processes such as ordering or K-state formation; these intra-phase transformations must affect differently the rates of all the elementary processes. c) In pure metals, the mechanism and rate of relaxation and, as a result, those of the other processes; also, the recrystallization capability of alloys cannot be evaluated solely from Q because there is no regular relation between it and the recrystallization temperature level; its significance is subsidiary. The recrystallization temperature-level is a more reliable criterion in spite of its limitation. This is the recrystallization range including starting and finishing temperature after relatively long annealing. The determination of the effective activation energy for pure metals and activation energies of elementary processes is of great intrinsic interest mainly for studying the process mechanism. A.A.Bochvar is mentioned in the article for his contribution in this field. There are

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Activation energy of ... 25916

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E111/E435

1 table, 6 figures and 12 references: 11 Soviet and 1 non-Soviet. The reference to an English language publication reads as follows: Anderson W.A., Mehl R.F. Trans.AIMME 1945, 161, 140.

ASSOCIATION: Moskovskiy institut stali im. I.V.Stalina
(Moscow Steel Institute imeni I.V.Stalin)

SUBMITTED: November 1960

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E111/E435

26562

18 9200

AUTHORS: Gorelik, S.S. and Spektor, E.N.

TITLE: Investigation of structural changes at small deformations followed by heating from analysis of X-ray interference intensity

PERIODICAL: Fizika metallov i metallovedeniye, 1961, Vol.12, No.2, pp.269-276

TEXT: Study of the mechanisms of small degrees of deformation of metals and alloys, and the effect of deformation, is important for elucidating the mechanisms of creep, "critical recrystallization", etc. The field of small deformations has not been sufficiently studied, leading to divergencies of opinion on the above phenomena. The authors have shown for nickel, and others for iron (Ref.1: Garrod R.J. and Auld J.H. Acta met., 1955, 3, No.2) that analysis of the blurring of X-ray lines by the approximation method is not suitable for detecting structural refinement, i.e. intra-grain displacements at small deformations. The results showed that the width of X-ray interference is not affected by the coherently-scattering regions which do not become less than 0.1 to 0.2 microns in size in structure dispersion at

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small deformations. It would be interesting to know whether at 10 to 12% deformation refinement of structure to regions less dispersed than 0.1 to 0.2 microns occurs. An answer could be provided with the aid of the primary-extinction effect. The object of the present work was to carry out such an investigation. Iron and a nickel-chromium (13% Cr) alloy were used, deformation of cylindrical specimens being effected by upsetting or impact, at deformation rates of 20 mm/min and 4 m/sec respectively. X-ray patterns were obtained from the middle of transversely cut cylindrical specimens (diameter about 30 mm) using an ionization X-ray installation with a copper and cobalt anode for the nichrome and iron, respectively. Steps were taken to avoid errors associated with time fluctuations in the operation of the counter by using a standard sample after each measurement. The standard consisted of a sample of the same composition, work hardened on an emery wheel. The size of coherent regions was determined with the aid of Darwin's equation. Analysis of structural changes at small deformations was effected from the change in the intensity of X-ray interference due to the influence of extinction and texture. Texture begins to appear in

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Investigation of structural ... S/126/61/012/002/012/019
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deformation the determination of the dimensions of coherently-scattering regions of massive specimens from the extinction effect on pairs of lines with different orders of reflection cannot be considered reliable. There are 4 figures and 7 references: 6 Soviet and 1 non-Soviet. The reference to an English language publication reads as follows: Garrod R. and Auld J.H. Acta met., 1955, 3, No.2.

ASSOCIATION: Moskovskiy institut stali im. I.V.Stalina
(Moscow Steel Institute imeni I.V.Stalin)

SUBMITTED: November 15, 1960

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E071/E180

18.7500

AUTHOR: Gorelik, S.S.

TITLE: Some relations in the recrystallization of metals and alloys

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Chernaya metallurgiya, no.1, 1962, 141-146

TEXT: The author's previous work and new experimental material enable him to formulate ideas on nucleation in primary recrystallization and on the driving forces, rates and temperature level of the process. Nuclei are considered to form in the lattice of the deformed metal at points of greatest disturbance, by a redistribution of dislocations, leading to the formation of undisturbed regions separated from the surrounding medium by highly curved boundaries with large disorientation angles. The expectation time of this redistribution is the incubation period. The greater the density and elastic energy of the dislocations and the less the inter-atomic bond strength, the easier their redistribution. The temperature dependence of the rate of primary recrystallization of metals and single-phase

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Some relations in the ....

alloys is mainly determined by the concentration and mobility of vacancies, and the temperature level by the mobility of dislocations. Therefore, increasing deformation reduces recrystallization temperature but has little effect on the effective activation energy. Polygonization is a competing process, which occurs in the high-temperature deformation of some alloys. The idea of the "critical nucleus", as normally understood, is not applicable to recrystallization. Such an idea would lead one to expect an acceleration of recrystallization on introducing surface-active additives into the metal, but this is contrary to all experimental evidence. The formation of mobile vacancies is of great practical importance and can explain for instance the quicker sintering of work-hardened powders. In the early stages, the growth of nuclei proceeds in the direction of maximum density of dislocations and vacancies. With further growth the new grains make contact and surface tension becomes an important factor. Because of the statistical nature of the occurrence of contacts the balance of surface tensions is constantly disturbed and localized acceleration of

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growth takes place compensating for the parallel retardation of growth due to the decrease in volumetric elastic stresses. Thus primary recrystallization is self-compensating as regards retarding factors. According to B.Ya. Pines (Ref.18: Uspekhi fiz. nauk, v.52, no.4, 1954) the accelerating effect of surface tension is due to a redistribution and directed displacement of vacancies. The relationship proposed by Mehl (Meyl), and by I.L. Mirkin and A.N. Kolmogorov (Ref.20: Sbornik trudov Moskovskogo instituta stali, no.X, 1938) for the rate of recrystallization is based on assumptions that are contrary to the present considerations. The complexity of the process prevents the formulation of a quantitative rate expression; the equations of Mehl and Avraami could be applicable to secondary recrystallization only. The effect of alloying is governed by its overall effect on inter-atomic forces and the factors stimulating it: atomic and vacancy mobility, elastic energy of dislocations and free surface energy and its lack of balance at boundary surfaces.
There are 20 references: 17 Soviet-bloc and 3 non-Soviet-bloc.
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Some relations in the ... S/148/62/000/001/010/015
E071/E180

The English language reference reads as follows:
Ref.15: W. Bollman, Journ. Inst. Metals, 87, 12, 1959.

ASSOCIATION: Moskovskiy institut stali
(Moscow Steel Institute)

SUBMITTED: October 20, 1961

Card 4/4

APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7"

"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

GORELIK, S.S.; SPEKTOR, E.N.

Investigating causes of a consertal structure of nichrome-base, heat-resistant alloys. Issl.po zharopr.splav. 8:178-183 '62. (MIRA 16:6)

(Nickel-chromium alloys--Metallography)

APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7"

"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

S/659/62/009/000/022/030
I003/I203

AUTHOR: Gorelik, S. S.

TITLE The relationship between the temperature range of recrystallization of alloys and the mechanism and forces which bring about this process

SOURCE: Akademiya nauk SSSR. Institut metallurgii. Issledovaniya po zharoprochnym splavam. v. 9. 1962. Materialy Nauchnoy sessii po zharoprochnym splavam (1961 g.),153-161

TEXT: Investigators do not agree on the correlation between the heat-resistance of alloys and the temperature range of their recrystallization. The investigation carried out on Fe—Co, Cu—Ni, Cu—Zn, Ni—Cr, and Al—Al_2O_3 metal powder alloys confirmed: 1) the absence of any relationship between recrystallization and the rate of self-diffusion in the non-deformed alloys, and 2) the fact that recrystallization, at least at certain of its stages, is due to a diffusion of groups of atoms. Alloying elements differ in their influence on each of the three factors determining the rate of recrystallization, the diffusion, the deformation and the energy of crystal planes. In the discussion, I. L. Mayevskiy expressed the opinion that the relationship between the mechanism of deformation and the recrystallization processes needs further investigation. There are 4 figures and 1 table.

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41631

S/148/62/000/009/006/007
E021/E483

18.1152

AUTHORS: Gulyayev, A.P., Gorelik, S.S., Sen'kina, M.S.

TITLE: Structural changes during cold-working and recrystallization of molybdenum

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Chernaya metallurgiya, no.9, 1962, 160-164

TEXT: The structural changes during deformation and subsequent annealing of cast molybdenum were studied in relation to the hardening and softening processes. Bars of commercially pure molybdenum were forged at 1600°C and annealed at 1200°C for 2 hours. Samples 13 mm thick were then cut from the bars, rolled at 500°C to 30 and 80% reduction and then annealed at temperatures of up to 1500°C. The changes in the structure were followed by X-ray diffraction. The microstresses and size of the regions of coherent scattering were determined. The beginning of recrystallization was determined by the usual X-ray method. Metallographic examination and hardness measurements were also carried out. After 80% reduction, hardness of Mo increased by a factor of 1.6; this increase in hardness was considerably less

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Structural changes ...

in the case of plastically deformed iron. The size of the regions of coherent scattering in molybdenum was also considerably greater in work-hardened iron. The block dimensions in Mo deformed to 80% reduction were in the region of 1100 Å. The microstresses in molybdenum and iron were approximately the same. The smaller degree of work-hardening of molybdenum as compared with other metals (iron) was thus associated with the less intense breaking-up of the coherent regions. Compared with massive Mo specimens, deformed by rolling, Mo filings were characterized by smaller block dimensions and lower microstresses. The temperatures of the beginning and the end of recrystallization after 30% reduction were, respectively, 1100 and 1500°C; the corresponding values for material given 80% reduction being 950 and 1100°C. There was no change in texture when the sample deformed to 80% reduction was heated up to 1000°C. There are 3 figures.

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Structural changes ...

ASSOCIATIONS: Moskovskiy vecherniy mashinostroitel'nyy institut
(Moscow Evening Machinery Institute)
Moskovskiy institut stali i splavov
(Moscow Steel and Alloys Institute)

SUBMITTED: November 2, 1961

Card 3/3

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

S/129/62/000/011/004/007
E193/E383

AUTHORS: Gorelik, S.S., Candidate of Technical Sciences, Vaynblat, Yu.M. and Malysheva, E.A., Engineers

TITLE: The role of zonal stresses in the formation of coarsely-crystalline surface layers during heating for solution-treatment of extruded aluminium alloys

PERIODICAL: Metallovedeniye i termicheskaya obrabotka metallov, no. 11, 1962, 21 - 23

TEXT: The fact that solution-treatment of extruded, age-hardenable aluminium alloys is accompanied by excessive grain growth in the surface layers has been attributed to more intensive decomposition of the solid solution in these regions. It has also been postulated that the excessive grain growth can be affected by the type and magnitude of residual stresses in extruded material. If the decomposition of the solid solution is accompanied by a decrease in its specific volume, the transformation should be accelerated in the regions of compressive residual stresses; the rate of decomposition, accompanied by expansion, should be accelerated in regions of tensile residual stresses. The core and the surface layer of

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The role of zonal stresses ....

extruded materials represent, respectively, zones of compressive and tensile residual stresses. In alloys in which the Al_6Mn phase is precipitated on ageing, decomposition of the solid solution is accompanied by an increase in its specific volume. The residual tensile stresses in the surface layer should, therefore, promote excessive grain growth. That such, in fact, is the case was proved by the present authors by experiments conducted on the alloy, avial (0.36% Cu, 0.63% Mg, 0.30% Mn, 0.31% Fe, 0.84% Si, 0.05% Zn and 0.05% Ti). A shape of an asymmetrical cross-section was extruded through a die so designed that the tensile residual stresses on one side of the profile were much larger than on the other; this resulted also in the shape curving up as it left the die. The distribution, type and magnitude of these stresses were changed in the next series of experiments, in which a guide rail was applied to prevent the curving up of the extruded shape. Metallographic examination of shapes extruded under various conditions showed that the outer zone of coarse grains formed in the extruded material during solution-treatment reflected the changes in the residual stresses. The more extensive was the zone of the residual tensile

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stress, the greater was the thickness of the surface coarsely-granular layer, the grain size in this layer increasing with increasing magnitude of the residual tensile stresses in this region. There are 2 figures.

ASSOCIATION: Moskovskiy institut stali i splavov
(Moscow Institute of Steel and Alloys)

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

GORELIK, S.S., kand.tekhn.nauk; VAYNBLAT, Yu.M., inzh.; MALYSHEVA, E.A., inzh.

Effect of pressure in avial alloy products. Metalloved. i term. obr. met. no.12:48-49 D '62. (MIRA 16:1)

1. Moskovskiy institut stali i splavov.
(Aluminum alloys--Metallography) (Pressure)

APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7"

"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

GORELIK, S.S.; YELYUTIN, V.P.; MOZZHUKHIN, Ye.I.; URAZALIYEV, U.S.; FUNKE, V.F.

X-ray investigation of recrystallization processes of titanium, zirconium, and molybdenum borides, and titanium and tungsten carbides. Izv. vys. ucheb. zav.; tsvet. met. 5 no.4:143-148 '62. (MIRA 16:5)

1. Moskovskiy institut stali, kafedry redkikh metallov, fiziki metallov i rentgenografii.
(Borides) (Carbides) (Crystallization)

APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7"

"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

GORELIK, Semen Samuilovich; RASTORGUYEV, Leonid Nikolayevich; SKAKOV, Yuriy Aleksandrovich. Prinimali uchastiye: BELIKOV, A.T.; VISHNYAKOV, Ya.D.; LYUTSAU, V.G., red.; VLADIMIROV, Yu.V., red.izd-va; BEKKER, O.G., tekhn. red.

[X-ray and electron diffraction examination of metals; practical guide to X-ray analysis, electron diffraction examination and electron microscopy] Rentgenograficheskii i elektronograficheskii analiz metallov; prakticheskoe rukovodstvo po rentgenografii, elektronografii i elektronnoi mikroskopii. Moskva, Metallurgizdat, 1963. 256 p.
[Supplement; calculation data tables and standard X-ray diffraction patterns] Prilozheniia; spravochno-raschetnye tablitsy i tipovye rentgenogrammy. 1963. 92 p.
(MIRA 17:1)

(Metallography) (Electron microscopy)
(Electron diffraction examination)

APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7"

"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

GORELIK, S.S.; SPEKTOR, E.N.

X-ray investigation of structural changes in certain crystals undergoing a slight deformation and subsequent heating. Fiz. met. i metalloved. 16 no.6:856-861 D '63. (MIRA 17:2)

1. Moskovskiy institut stali i splavov.

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

L 10814-65 EWT(m)/EPR/T/EWP(k)/EWP(b) Pt-4/Ps-4 ASD(m)-3/SSD(a)/BSD
ACCESSION NR: AT4043511 JD S/3107/64/000/003/0159/0169

AUTHOR: Gorelik, S. S. (Doctor of technical sciences); Litvintsev, A. I. (Candidate of technical sciences); Belova, E. P. (Engineer)

TITLE: Study of recrystallization of sintered aluminum powder (SAP)

SOURCE: Nauchno-tekhnicheskoye obshchestvo mashinostroitel'noy promy*shlennosti. Sektsiya metallovedeniya i termicheskoy obrabotki. Metallovedeniye i termicheskaya obrabotka, no. 3, 1964. 159-169

TOPIC TAGS: aluminum powder, sintered aluminum powder, SAP, SAP cold rolling, SAP hot rolling, rolled recrystallization, SAP recrystallization

ABSTRACT: The recrystallization mechanism of hot and cold rolled SAP with 4% Al_2O_3 was investigated. The hot extruded SAP billets were hot rolled in three steps at 450—480C with 12.5, 22, and 22% reduction, and then cold rolled with 65% reduction. The rolled specimens were annealed at 150—700C for 1 hr and air cooled. The formation of recrystallization centers in the cold-rolled specimens was [illegible]

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ACCESSION NR: AT4043511

begin at the same temperature as in pure aluminum, i.e., at 200—225C, whereas the grain growth begins at 350—375C owing to the retarding action of Al_2O_3 particles. Accordingly, the hardness-annealing temperature curve shows hardness drops at 200—250C and at 350—400C (see Fig. 1 of the Enclosure). The x-ray diffraction patterns showed that heating of cold-rolled SAP to 250C is accompanied by a diminishing of scattering caused by texture. Heating to 450C almost completely eliminates the texture maxima. The x-ray diffraction patterns of hot-rolled SAP are identical to those of ... billets. Only at 625C, i.e., close to the melting point of aluminum, does the texture scattering increase, indicating what is apparently the beginning of grain growth. An interesting phenomenon observed during these experiments was a migration of insoluble oxide particles in a solid matrix under the effect of diffusion processes of nuclei growth. The phenomenon is brought about by a redistribution of vacancies occurring under the effect of surface tension. Orig. art. has: 4 figures.

ASSOCIATION: Nauchno-tekhnicheskoye obshchestvo mashinostroitel'noy promy°shlennosti (Scientific Technical Society of the Machine Construction Industry)

Card 2/4

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

L 10814-65
ACCESSION NR: AT4043511

SUBMITTED: 00	ATD PRESS: 3117	ENCL: 01
SUB CODE: MM	NO REF SOV: 006	OTHER: 006

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

L 10814-65
ACCESSION NR: AT4043511

ENCLOSURE: 01

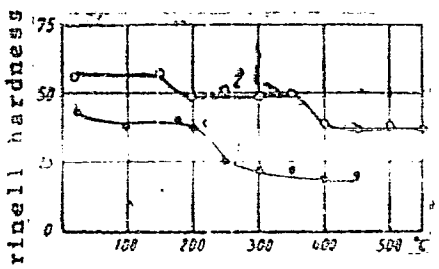

Fig. 1. Dependence of hardness of cold rolled (65% reduction) aluminum (1) and SAP (2) on annealing temperature.

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

ACCESSION NR: AP4040685 S/0129/64/000/006/0005/0008

TITLE: The effect of iron on the formation of a coarse crystalline ferrule in Al-alloys

SOURCE: Metallovedeniye i termicheskaya obrabotka metallov, no. 6, 1964, 5-8

AUTHOR: Gorelik, S. S.; Kozlovskaya, V. P.; Tomilova, L. A.

TOPIC TAGS: ferrule, crystalline ferrule, saturated solid solution, grain coarseness, Fe, Al alloy, recrystallization

ABSTRACT: The authors verify earlier investigations concerned with the formation of a coarse crystalline ferrule in saturated solid solutions. They also study the effect of individual alloying elements in different concentrations on the formation of ferrule. In this connection, the effect of Fe was observed in hot-pressed specimens. The authors account for the coarsening of the structure under the effect of Fe additions in excess of 0.2% to Al-Cu, Al-Mn, Al-Si, Al-Cu-Mn and "D16" alloys by the formation of finely dispersed and unevenly distributed particles of the ferrous second phase

Card 1/2

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

ACCESSION NR: AP4040685

during the decomposition of the saturated solid solution of Fe in Al in the process of pressing as well as by the local dissolution of the excess phases during hardening. The structure with a variable grain size that forms on the periphery of pressed 40 diam, 90 mm-long rods as a result of primary recrystallization tends to coarsen drastically during secondary recrystallization under the action of hardening. The higher the iron contents, the coarser the grains during secondary recrystallization. In the zone around the core the grain size reaches a maximum after the addition of 0.16% Fe and decreases gradually upon further Fe additions. A zone of potentially coarse grained ferrule in hot-pressed Al alloys appears in the form of a dull ferrule with an etchability that differs from that of the core. The orig. art. has: 3 figures and 1 table.

ASSOCIATION: Moskovskiy institut stali i splavov (Moscow Institute of Steel and Alloys)

SUBMITTED: 00 ENCL: 00

SUB CODE: MM NR REF SOV: 004 OTHER: 001

Card 2/2

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

L 16007-65 EWT(m)/EPR/EWP(t)/EWP(b) Pe-4 IJP(c)/ASD(a)-5/ASD(m)-3 JD/JG
ACCESSION NR: AP5001944 S/0148/64/000/007/0165/0170

AUTHOR: Bublik, V. T.; Gorelik, S. S.

TITLE: Effect of impurities on recovery and recrystallization of copper deformed at 78°K

SOURCE: IVUZ. Chernaya metallurgiya, no. 7, 1964, 165-170

TOPIC TAGS: copper, copper base alloy, aluminum containing alloy, beryllium containing alloy, metal deformation, recrystallization, crystal dislocation, liquid hydrogen, electric resistance, x ray diffraction

Abstract: The following alloys were studied: Cu-Al (0.04% and 0.2% Al) and Cu-Be (0.04% and 0.2% Be), and Cu (99.995% Cu). The investigation was made chiefly by measuring electrical resistance. In addition, [illegible] the start of recrystallization (T_r) was determined by x-ray [illegible] lowering of the recrystallization temperature leads to a [illegible] lower in pure copper and higher in the alloys (40 and 60°, respectively). The temperature of the end of recrystallization (T_r^e) remains practically constant, as a result of which the recrystallization range expands with a lowering [illegible]

Card 1/2

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

L 16007-65
ACCESSION NR: AP5001944

deformation temperature. In addition, within the limits of the same deformation temperature, the recrystallization range depends on composition. Depending upon the [illegible] concentration of the impurity, [illegible] may [illegible] Al even in the amount of [illegible] does not retard mobility and does not increase the recrystallization range. In this case, Al interacts mainly with the dislocations, forming "clouds" and hindering the start of dislocation redistribution. After the [illegible] Al no longer has any effect [illegible] titanium in the amount of 0.04 at. % raises T_p^2, retards recovery very slightly, and expands the recrystallization range slightly. An increase in its concentration to 0.2 at. % leads to a more pronounced retardation of recovery and a greater expansion of the recrystallization range. [illegible] clude that there is a relationship between this retardation and [illegible] 5 figures and 1 table.

ASSOCIATION: Moskovskiy institut stali i splavov (Moscow Institute of Steel and Alloys)

SUBMITTED: 27Feb64 ENCL: 00 SUB CODE: MM, SS

NO REF SOV: 003 OTHER: 002 JPRS

Card 2/2

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"APPROVED FOR RELEASE: 06/13/2000 CIA-RDP86-00513R000516130008-7

L 8646-65 EWT(m)/EWP(w)/T/EWP(k)/EWP(b) Pf-4 MJW/JD/HW

ACCESSION NR: AP4044136 S/0129/64/000/008/0029/0033

AUTHOR: Gorelik, S. S.; Spektor, Ya. I.; Spektor, E. N.; Konovalov, B. O.

TITLE: Inhomogeneity of the structure of steel tubes after thermo-mechanical treatment

SOURCE: Metallovedeniye i termicheskaya obrabotka metallov, no. 8, 1964, 29-33

TOPIC TAGS: martensitic low alloy steel, 40KhSNA steel, steel thermo-mechanical treatment, treated steel structure, structure inhomogeneity, steel property

ABSTRACT: A study has been made of the structural changes along the cross section of high-strength tubes made of low-alloy [illegible] martensitic steel after low-temperature thermomechanical [illegible]

[illegible]

[illegible] along the tube [illegible]

Card 1/3

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